

Natural Recovery of PCB-Contaminated Sediments at the Sangamo-Weston/ Twelvemile Creek/Lake Hartwell Superfund Site

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Monitored Natural Recovery

- Monitored Natural Recovery (MNR) of sediments is a remedial option that relies on natural environmental processes to permanently reduce risk, and which includes careful assessment, modeling, and monitoring to ensure success (RTDF)
- Natural processes most often associated with MNR:
 - Sediment containment through **natural capping**
Requires net depositional areas
 - Contaminant **weathering**
 - Biological Processes
 - Physical/chemical processes
 - Contaminant sorption/sequestration

Natural Recovery Program Objective

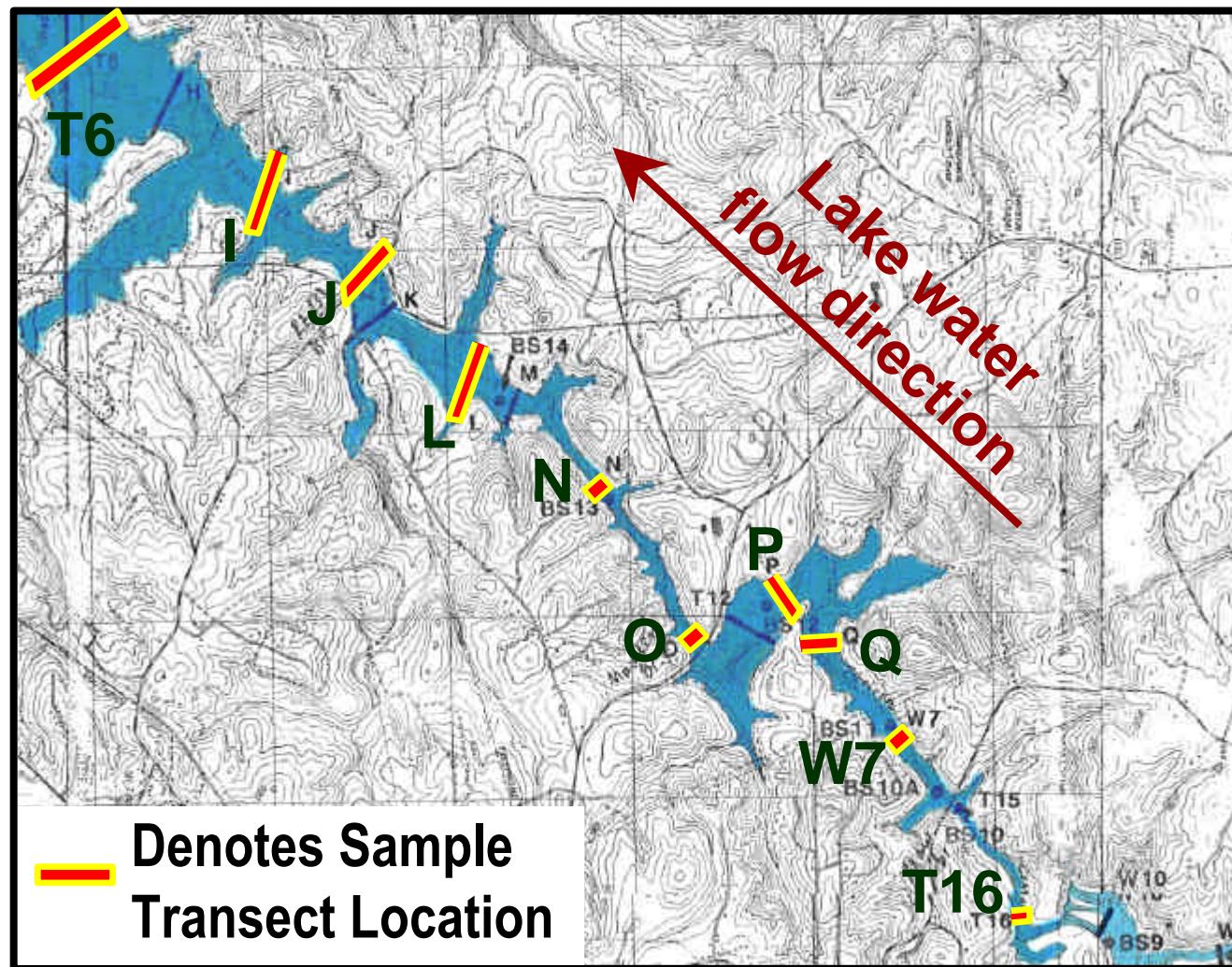
- Investigate natural recovery of contaminated sediments at two sites
 - **PCB-contaminated sediments**
Sangamo-Weston/Twelvemile Creek/
Lake Hartwell Superfund Site (Pickens County, SC)
 - **PAH-contaminated sediments**
Wyckoff/Eagle Harbor Superfund Site
(Bainbridge Island, WA)
- Develop **field evaluation** techniques
- Use a **snapshot** approach

Sample Collection at Lake Hartwell



- Collected sediment cores
- Extruded cores into 5-cm segments

Lake Hartwell Site Map

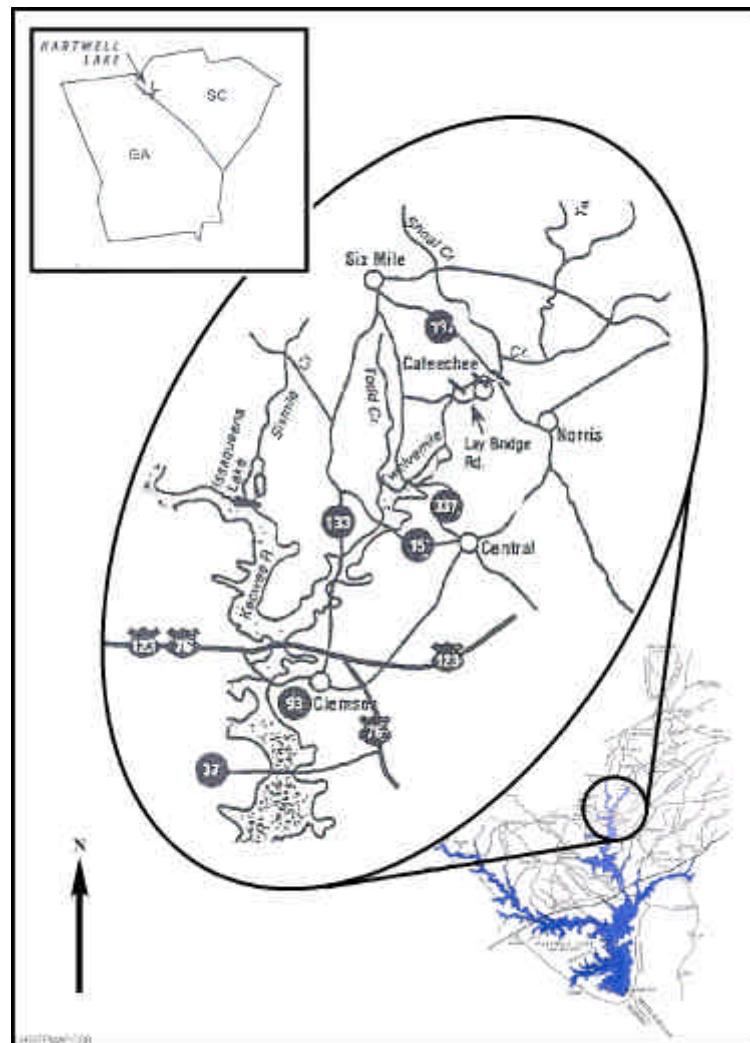


- Sediment cores at 10 locations
- Locations matched USEPA transects
- Extruded samples after coring

Transect Locations

T16, W7, Q, P, O, N, L, J, I, T6

Lake Hartwell Site, South Carolina

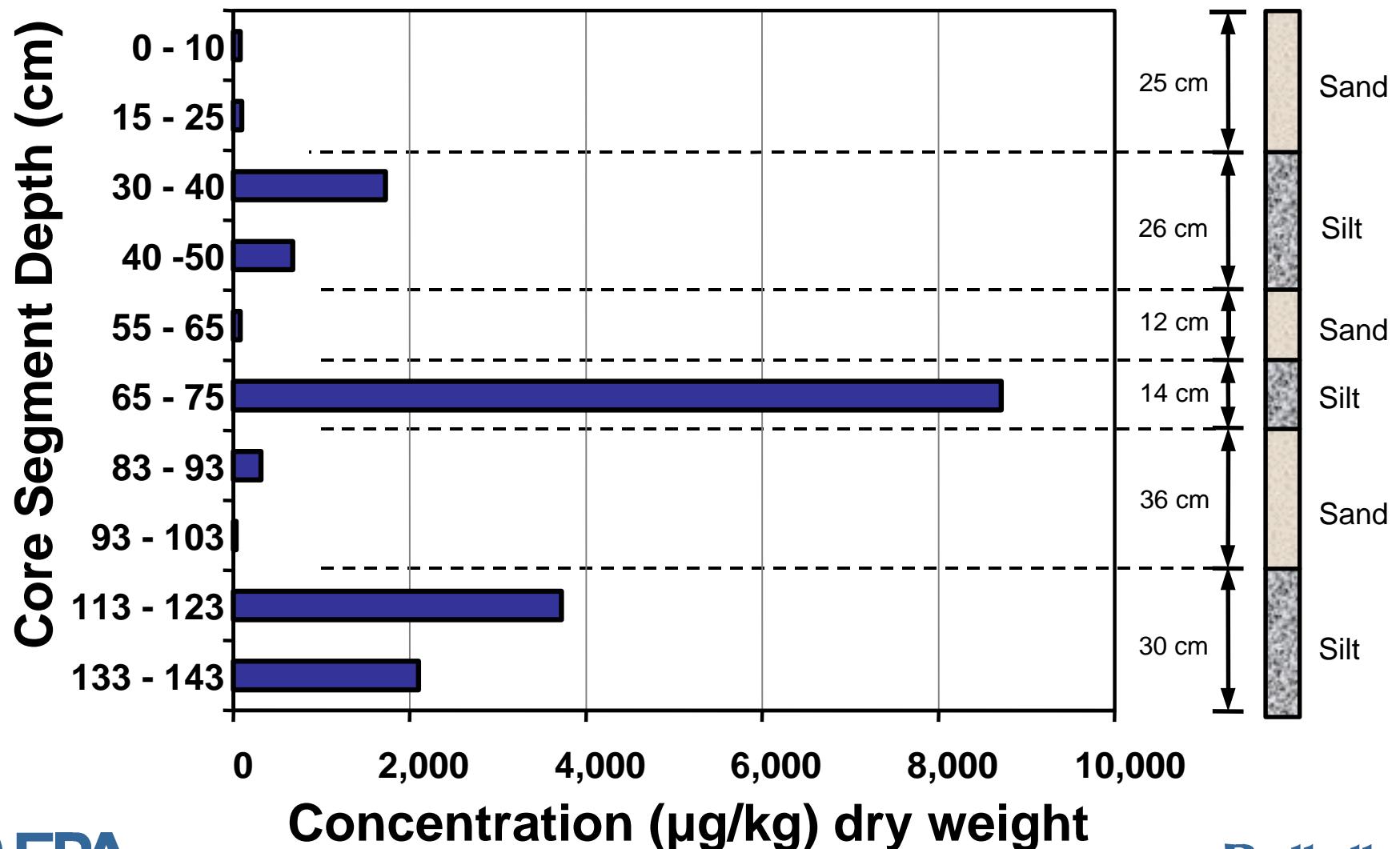


- Documented history of contaminated sediments
 - Capacitor Manufacturing (1955-1978)
 - Single primary PCB source (Aroclors 1016, 1242, and 1254)
- Natural Recovery selected to restore Lake Hartwell sediments (EPA/ROD/R04-94/178)
- Terrestrial PCB contamination has been removed/contained

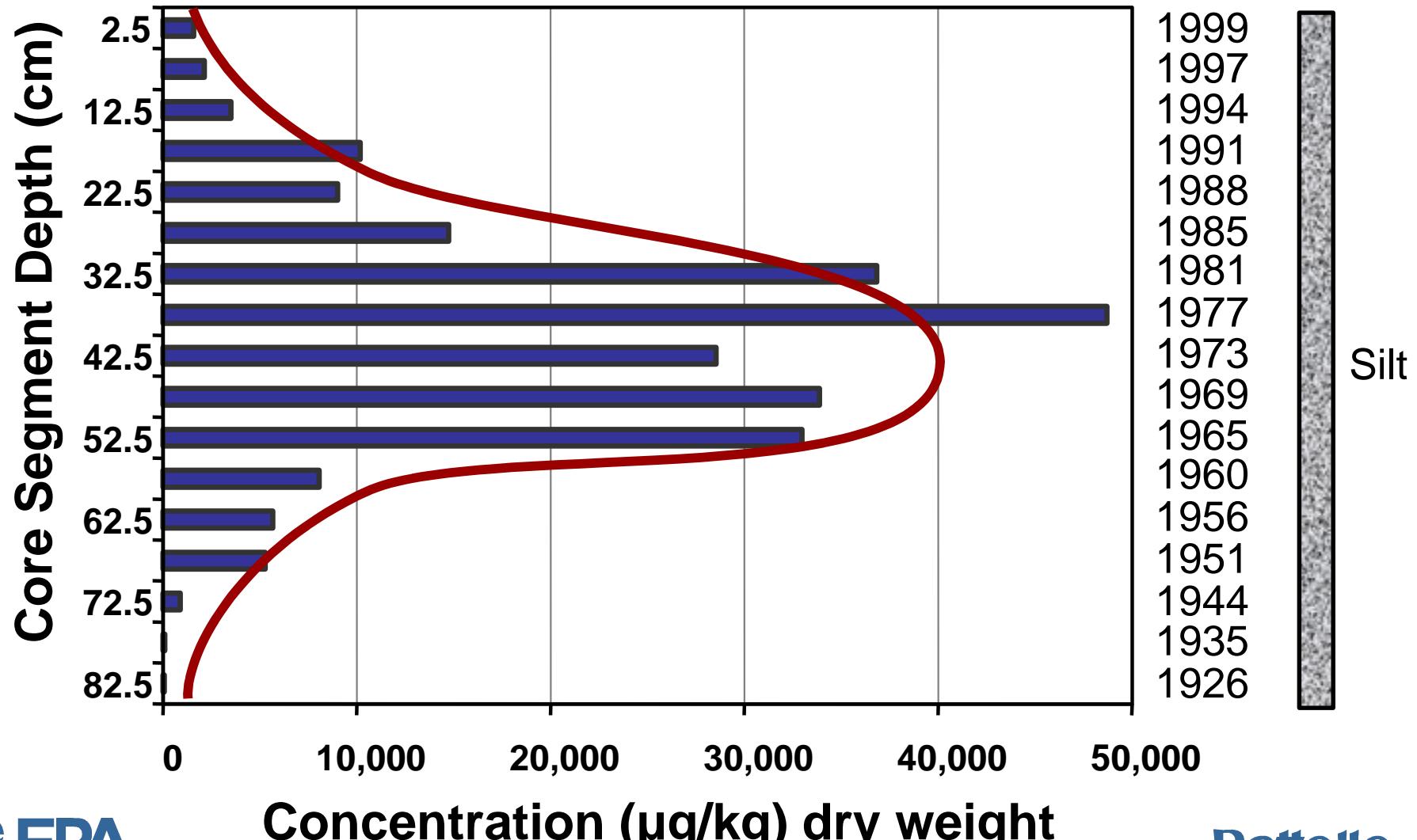
Lake Hartwell Results

- Vertical and horizontal PCB distribution
- Sediment age dating and sedimentation rates
- PCB homologue and congener distribution analyses

Vertical t-PCB Concentration Profile Transect Q (Upgradient)



Vertical t-PCB Concentration Profile Transect L (Downgradient)



Estimated Sedimentation (cm) to Achieve Sediment Cleanup Goals

Core	1 mg/kg t-PCB	0.4 mg/kg t-PCB	0.05 mg/kg t-PCB
O	2.8	16	45
N	0	7.8	29
L	2.7	11	31
I	0	11	42
T6	0	3.5	13
Avg.	1.2 ± 1.7	10 ± 4.7	32 ± 13

- **1 mg/kg:** ROD surface sediment cleanup goal (EPA, 1994)
- **0.4 mg/kg:** Mean site-specific sediment quality criteria (EPA, 1994)
- **0.05 mg/kg:** NOAEL effects range-low (EPA, 1994)

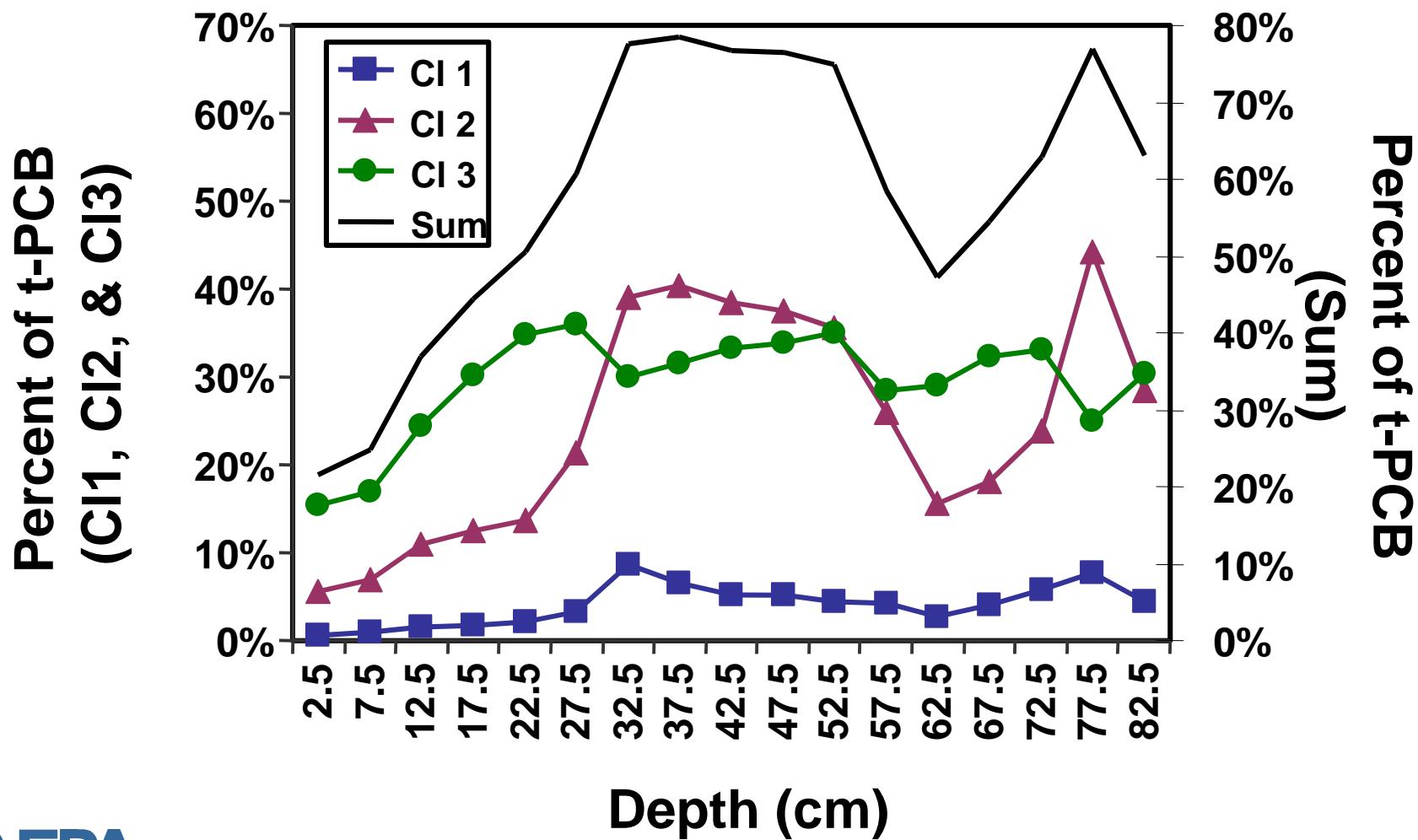
Estimated Time (yrs) to Achieve Sediment Cleanup Goals

Core	1 mg/kg t-PCB	0.4 mg/kg t-PCB	0.05 mg/kg t-PCB
O	1 - 3	8 - 10	> 28
N	—	5 - 10	25 - 30
L	3 - 5	5 - 7	15 - 20
I	—	2 - 5	10 - 15
T6	—	2 - 5	10 - 15
Range	1 - 5	2 - 10	10 - 30

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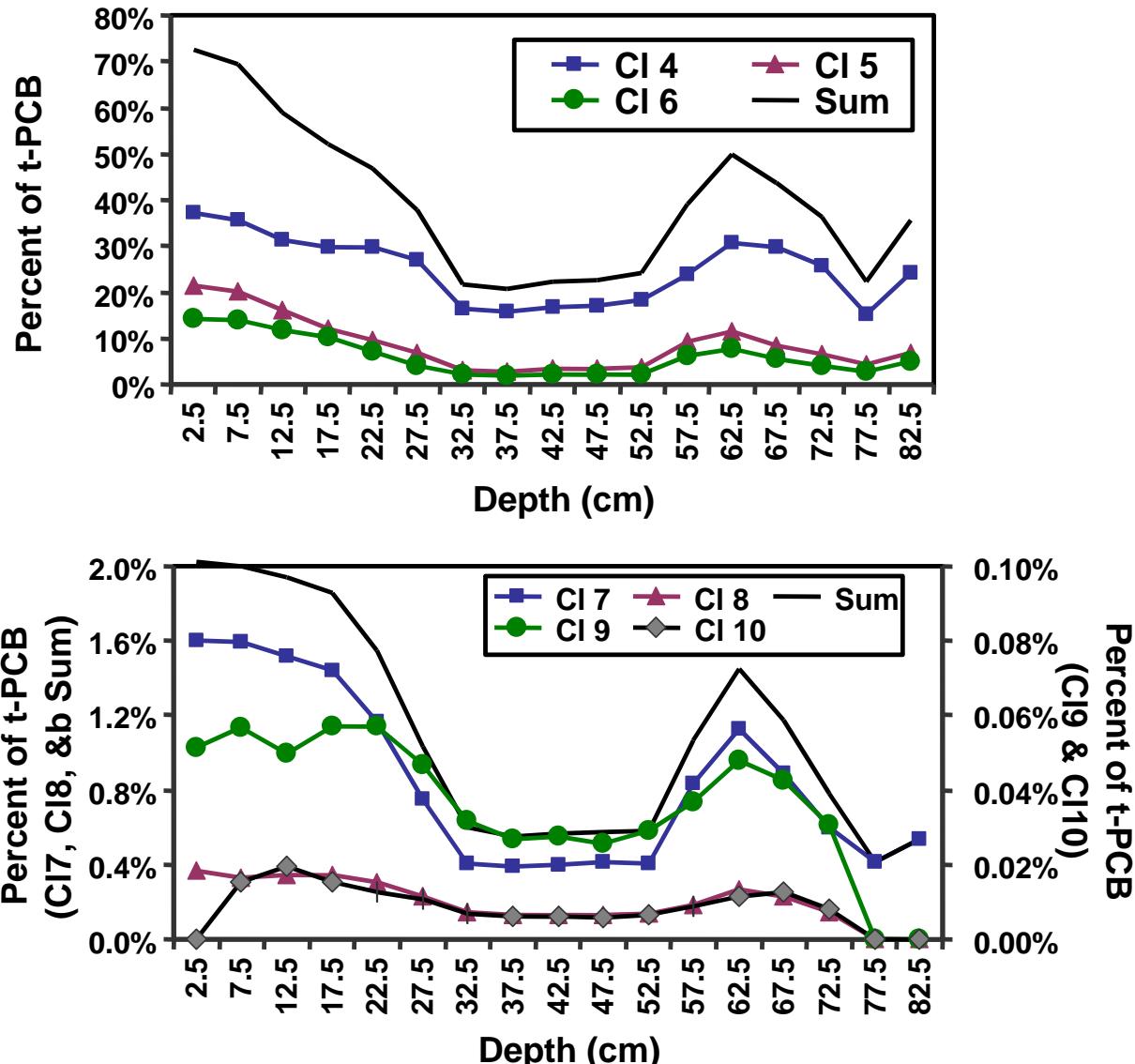
Core L Homologue Plots

Cl-1 through Cl-3

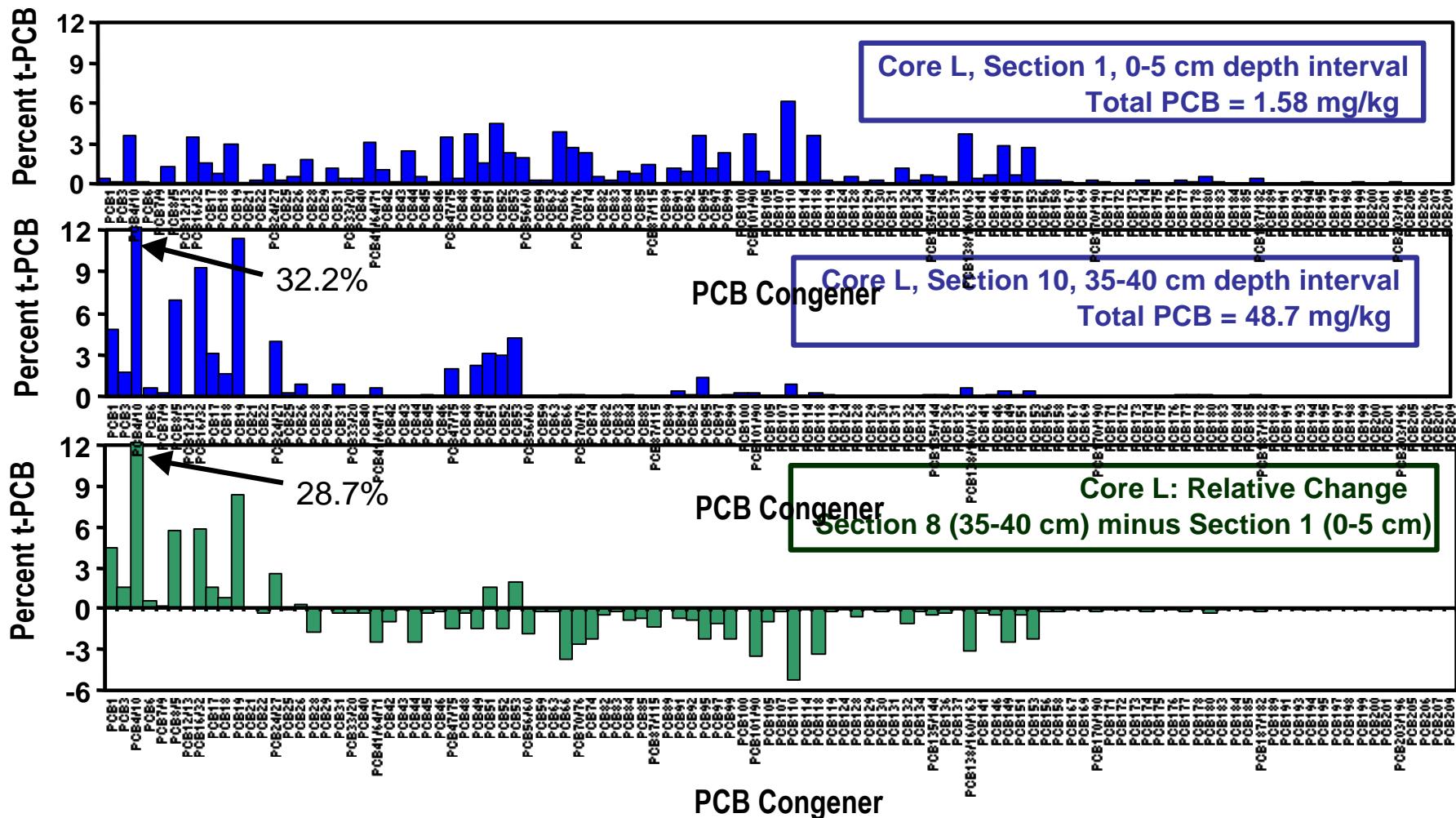


Core L Homologue Plots

Cl-4 through Cl-10



PCB Congener Distribution in Surface and Deep Sediments



Major Congener Shifts Observed Between Core Segments L-1 and L-8

IUPAC No.	Congener Name	Percent Change
PCB 1	2-chlorobiphenyl	4.4
PCB 4/10	2,2'/2,6-dichlorobiphenyls	29
PCB 8/5	2,4'/2,3-dichlorobiphenyls	5.8
PCB 16/32	2,2',3/2,4',6-trichlorobiphenyls	5.8
PCB 19	2,2',6-trichlorobiphenyl	8.4
PCB 24/27	2,3,6/2,3',6-trichlorobiphenyls	2.5
PCB 66 -156	tetra- through hexachlorobiphenyls	-45

Summary and Conclusions

- Highest t-PCB associated with silt/clay layers
- Decreasing surface t-PCB, at or approaching 1.0 mg/kg
(Max surface PCB = 1.58 mg/kg at Transect L)
- Time to achieve surface sediment concentrations
 - 0 to 5 yrs to achieve 1.0 mg/kg
 - 2 to 10 yrs to achieve 0.4 mg/kg
 - 10 to 30 yrs to achieve 0.05 mg/kg
- Homologue shifts from higher to lower chlorinated congeners
 - Cl4/Cl5/Cl6 congeners reduced from 80% to 20% t-PCB with depth and time
 - Cl1/Cl2/Cl3 congeners increased from 20% to 80% t-PCB with depth and time
- Significant accumulation of ortho chlorinated congeners

Effectiveness of Natural Recovery Approach

- Sediment isotope analyses provided an effective means of calculating sedimentation rates and surface sediment recovery rates
- High resolution PCB chromatography (107 congeners eluted) used to characterize vertical PCB dechlorination with sediment depth and age
- Evaluate relationship of sediment contamination with benthic animals and fish
- Assess long-term stability